GEO-TEST

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JEO-TEST

GEOTECHNICAL ENGINEERING SERVICES, JOB NO. 1-80706 EL CAMINO REAL INTERNATIONAL HERITAGE CENTER EAST OF I-25 EXIT 115, NEW MEXICO

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PREPARED FOR:

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August 20, 1998
File No. 1-80706

Ms. Michele Mullen, AIA
Holmes Sabatini Associates, Architects
202 Central Avenue SE, West Courtyard
Albuquerque, New Mexico 87102

RE: Geotechnical Engineering Services
El Camino Real International Heritage Center
East of I-25 Exit 115, New Mexico

Dear Ms. Mullen:

Geo-Test, Inc. is pleased to submit our Geotechnical Engineering Services Report for the above referenced project. The report contains the results of our field investigation and laboratory testing; recommendations for foundation, floor slab, and retaining wall design; pavement section thickness design, and criteria for site grading.

It has been a pleasure to serve you on this project. If you should have any questions, please contact me in our Albuquerque office at (505) 857-0933.

Sincerely,
GEO-TEST, INC.

CHARLES M. MILLER
NEW MEXICO
6018
REGISTERED PROFESSIONAL ENGINEER

Charles M. Miller, P.E.

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INTRODUCTION

This report presents the results of geotechnical engineering services performed at the site of the proposed El Camino Real International Heritage Center, located midway between Socorro and Truth or Consequences, New Mexico, approximately 3 miles east of the I-25 Exit 115.

The objective of the services is to:

1) Determine the nature and engineering properties of the subsurface soils.

2) Provide recommendations for the design and construction of foundations, floor slabs, retaining walls, pavements, and general site grading.

The services include subsurface exploration, representative soil sampling, laboratory testing of samples, performing an engineering analysis, and preparation of this report.

PROPOSED CONSTRUCTION

It is understood that the structure will be one story with a basement. Basement walls will be reinforced concrete. The above grade walls will be constructed with light gage bearing studs or with post and beam construction. Maximum loads will be on the order of 100 kips for columns and 4 klf for bearing walls.

Should structural loads and/or construction details vary significantly from those outlined above, **Geo-Test** should be notified for review and possible revision of recommendations contained herein.

FIELD EXPLORATION

Seven exploratory borings were drilled for the project at the locations shown on Figure 1, Boring Location Map. The borings were advanced and soil samples obtained to evaluate soils beneath the proposed construction. The borings were drilled using a truck-mounted drill rig utilizing 5 inch O.D. by 2¼ inch I.D.

hollow-stem auger. The borings were advanced to depths of 5 to 30.5 feet below existing grade.

Subsurface soils were sampled at depths of 2½ feet, 5 feet, and at 5 feet intervals thereafter, utilizing a standard split-spoon sampler driven by a standard penetration test hammer. The texture, moisture content, relative density, color, and other physical properties of soils were observed and noted by the field engineer. Samples along with drill cuttings were visually classified to maintain a continuous geologic/lithologic log of the boring. Boring logs are presented at the end of this report.

Percolation tests were performed at the approximate location indicated on the Boring Location Map.

LABORATORY TESTING

Representative samples were tested in the laboratory to determine certain engineering properties of the soils. Moisture contents were determined to evaluate the various soil deposits both with depth and laterally. Sieve Analysis and Atterberg Limits Tests were performed to aid in soil classification.

The results of these laboratory tests are presented in the Tabulation of Laboratory Test Results and on the Boring Logs in subsequent sections of this report. All soil samples will be discarded 30 days after the date of this report unless we receive a specific request to retain the samples for a longer time.

SUBSURFACE SOIL CONDITIONS

As encountered in the exploratory borings, the soils across the site are fairly uniform and consist primarily of medium dense to very dense slightly silty to silty sand with gravel and cobbles and sandy, slightly silty gravel with cobbles. Very stiff to hard sandy, clayey silt with gravel was encountered at various depths in several of the borings. Some clayey sand was encountered in the deeper portion of some of the borings. Please refer to the Boring Logs for detailed strata descriptions.

Laboratory testing found low to moderate soil moisture contents. Groundwater was not encountered in any boring. Please refer to the boring logs at the end of this report for detailed strata descriptions.

Percolation rates of 9.5 and 15.2 inches per minute were measured in Perc 1 and Perc 2, respectively.

SITE SEISMICITY

The site is located in Seismic Zone 2B, as defined in the 1997 UBC. Both S_c and S_d soil profiles exist on the site. We recommend using the S_d profile for design. The following seismic criteria should be used:

SEISMIC ZONE FACTOR (Z) = 0.20
SEISMIC COEFFICIENT (C_a) = 0.28
SEISMIC COEFFICIENT (C_v) = 0.40

The general geology of the site is shown on Figure 2, Geologic Map. The map scale is 1:1,000,000, therefore, all of the details available may not be presented in graphical form. On this map, the nearest fault is located apprxomately 3 miles to the east. The nearest fault used by the USGS for development of the USGS 1996 Hazard maps is the Caballo Fault. The Caballo Fault is a Seismic Source Type B. This fault extends from Lat. 33.24, Long. 107.15 to Lat. 32.64, Long. 107.06. The subject site is located at approximately Lat. 33.59, Long. 107.09. The northern end of the Caballo Fault is approximately 24 miles south and 2.5 miles east of the subject site.

The nearest USGS probabilistic ground motion grid point is located at Lat. 33.1, Long. 107.3. The probabilistic ground motion values, in %g, at this point are:

	10%PE in 50 yr	5%PE in 50 yr	2%PE in 50 yr
PGA	5.7	8.17	13.3
0.2 sec SA	12.57	18.46	29.83
0.3 sec SA	11.63	16.89	26.91
1.0 sec SA	3.81	5.57	8.86

CONCLUSIONS

As indicated by standard penetration tests the sands, gravels and silt at potential foundation depths are dense to very dense and very stiff to hard, respectively. Considering the relative density of the soils encountered in the borings, building foundations, floor slabs, and retaining wall footings should bear on compacted soils as detailed in the site grading section of this report.

The following sections of this report provide detailed recommendations for design of foundations, slab on grade floors, retaining walls, and pavements. Guide specifications for site grading are also presented.

FOUNDATIONS

Shallow spread and strip type footings bearing on compacted site soils may be used for the proposed structure, provided soil compaction and site grading recommendations are followed. An allowable soil bearing pressure of 3,000 pounds per square foot is recommended for the design of footings. The bearing value refers to full dead plus realistic live loads and can be safely increased by one-third for loading of short durations due to the effect of wind or seismic forces.

Exterior footings should be established a minimum of 2.0 feet below lowest adjacent grade while interior footings should be at least 12 inches below finished floor grade. Minimum widths of continuous and isolated footings should be 1⅓ and 2 feet respectively.

Bearing surfaces should be cleaned of all loose, disturbed material prior to concrete placement. All foundation systems (footings, grade beams, stem walls, turned down slabs, or thickened slabs) should be adequately reinforced to minimize the effects of differential settlement.

SETTLEMENT OF FOOTINGS

Settlement of properly designed and constructed footings carrying the maximum anticipated loads are estimated not to exceed 1 inch for total settlement and ½ inch differential settlement. These values are for soil moisture contents encountered at the time of sampling or those necessary for compaction during construction.

LATERAL LOADS

Resistance to lateral forces can be assumed to be provided by soil friction on the footings and floor slabs and by passive earth resistance. A coefficient of friction of 0.40 should be used for computing the lateral resistance between bases of footings and slabs with soil. This coefficient should be reduced to 0.30 when used in conjunction with passive pressure. With backfill as recommended in the site grading section of this report, a passive soil resistance equivalent to a fluid weighing 325 pounds per cubic foot should be used for analysis. An active lateral soil pressure equivalent to a fluid weighing 35 pounds per cubic foot should be used. An at-rest lateral soil pressure equivalent to a fluid weighing 55 pounds per cubic foot should be used.

SLABS ON GRADE

If grading requirements are complied with, concrete slabs on grade may be supported on compacted site soils. Floor slabs should be separated from utilities to allow their independent movement. If required as a working surface, a 4 inch course of gravel should be placed on properly prepared subgrade. The gravel base should consist of 1 inch maximum size aggregate with less than 15% passing the No. 200 sieve.

The gravel base will act as a capillary barrier, but will not totally eliminate moisture intrusion. If this is critical, an impervious membrane barrier should be placed beneath the slabs with 2 inches of clean non-plastic sand overlying the barrier to minimize differential cracking and curling of floor slabs.

Slabs should be separated from all foundation elements (stem walls, basement walls, etc.) and utilities which penetrate the slab to allow their independent movement.

BASEMENT CONSTRUCTION

Restrained basement walls should be designed to withstand lateral pressures based on "at-rest" soil pressure. With backfill as recommended in the site grading section of this report, a at-rest soil pressure equivalent to a fluid weighing 55 pounds per cubic foot should be used for analysis. Basement walls should not be backfilled until adequate support (floor framing, etc.) is in place.

Exterior basement walls should be waterproofed, and a drain system should be constructed outside of the basement wall and below the interior basement floor as a precaution against future moisture intrusion. The drain should be constructed with 4 " diameter perforated PVC pipe sloped a minimum of 1/8" per foot. The pipe should be covered with a minimum of 12" of clean 3/4" - 3" gravel. The gravel should be protected from soil intrusion from backfill materials with filter fabric or 30# building felt. The system should drain to a positive gravity outfall or a pumpable sump.

RETAINING WALLS

Retaining walls should be founded on conventional spread footings bearing on native soils compacted in accordance with the criteria outlined in the site grading section of this report. Footings should be designed for a maximum soil bearing pressure of 2,000 pounds per square foot and be established a minimum of 2.0 feet below lowest adjacent grade.

Retaining walls, which are free to rotate or translate such that the top of the wall can deflect laterally a distance equal to 0.001 times the height of the wall, should be designed to resist an active lateral earth pressure equal to 35 pounds per square foot per foot of depth. Walls which are restrained from movement should be designed for an at-rest pressure of 50 pounds per square foot per foot of depth. These pressures assume no build up of hydrostatic pressures behind the wall. To prevent the buildup of hydrostatic pressures, adequate weep holes or composite drainage systems such as Miradrain or GeoTech Drainage Board can be readily installed by attaching to the backside of a subgrade wall prior to backfilling. The drainage layer would be connected to a perforated collector pipe at the base of the wall and routed to a sump or to a positive gravity drain.

As an alternative, the conventional french drain type system comprised of free draining granular fill can be placed behind the walls. A perforated PVC drainage pipe would be placed at the bottom of the wall to collect water from the granular fill. A filter fabric should encapsulate the granular fill to control migration of fines into the drain.

To minimize the potential for saturation of the backfill by infiltration of surface water, the ground surface behind retaining walls should be sloped to drain away from the structure at a minimum 2 percent slope.

During backfilling, only hand operated compaction equipment should be used within about 5 feet horizontally from the back of the wall. The use of heavier equipment could apply lateral pressures well in excess of the earth pressure, particularly over the upper portions of the wall.

SITE GRADING AND COMPACTION

The following general guidelines should be included in the project construction specifications to provide a basis for quality control during site preparation. It is recommended that any controlled fill and backfill be placed and compacted under engineering supervision and in accordance with the following:

1) Prior to placement of foundations or slabs, the soils at footing bearing surfaces and within the building areas shall be densified. Ground preparation for foundation and slab bearing surfaces shall consist of scarifying the subgrade soils to a depth of approximately 12 inches. The soils should be conditioned as necessary to achieve near optimum moisture content for compaction. The soils shall then be compacted as required to achieve 95 percent of the ASTM D-1557 maximum dry density.

2) Ground preparation for areas to receive fill and final cut areas shall consist of scarifying the subgrade soils to a depth of approximately 12 inches. The soils should be conditioned as necessary to achieve near optimum moisture content for compaction. The soils shall then be compacted as required to achieve 95 percent of the ASTM D-1557 maximum dry density.

3) Ground preparation for pavements shall consist of removing deleterious materials and scarifying the subgrade soils to a depth of approximately 12 inches. The soils should be conditioned as necessary to achieve near optimum moisture content for compaction. The soils shall then be compacted as required to achieve 95 percent of the ASTM D-1557 maximum dry density.

4) The native site soils may be used as controlled fill provided they are free of debris or deleterious materials. Some of the on site soils may contain cobbles that may exceed 6", which would require removal prior to use as backfill and controlled fill. All backfill and controlled fill material shall be non expansive, free of vegetation and debris, and contain no rocks larger than 6 inches. Gradation of the backfill material, as determined in accordance with ASTM D-422, should be as follows:

Sieve Size	Percent Passing
3 inch	90-100
No. 4	60-100
No. 200	5-50

5) The plasticity index should be no greater than 12 when tested in accordance with ASTM D-4318.

6) Fill (controlled or general) or backfill, consisting of soil approved by the Geotechnical Engineer, shall be placed in controlled compacted layers with approved compaction equipment. Lifts shall be no more than 8 inches thick prior to compaction. All compaction shall be a minimum of 95 percent of maximum dry density determined in accordance with ASTM D-1557.

7) Tests for degree of compaction shall be determined by the ASTM D-1556 or D-2922 methods. Observation and field tests shall be conducted by the Geotechnical Engineer during fill and backfill placement to assist the contractor in obtaining the required degree of compaction. If less than 95 percent relative

compaction is indicated, additional compactive effort shall be made with adjustment of the moisture content as necessary until 95 percent compaction is obtained.

CONSTRUCTION EXCAVATION SLOPES

Excavated slopes for foundation and utility construction should be designed and constructed in accordance with 29 CFR 1926, Subpart P, and any applicable state or local regulations. Temporary construction slopes should not exceed 1.5 horizontal to 1.0 vertical.

PAVEMENTS

Based on the results of laboratory testing and analysis performed in accordance with publications prepared by the Asphalt Institute, a minimum asphaltic pavement section of 3.0 inches of asphaltic concrete over 12 inches of compacted blended subgrade is recommended for areas subject to light automobile traffic and parking areas. Where traffic lanes are subject to heavy automobile and truck traffic the above section should be thickened by an additional one inch of asphalt pavement.

Portland cement concrete pavement should be used in areas subjected to truck traffic including delivery trucks (loading docks), and trash collection trucks (dumpster access), or as an alternative to asphaltic concrete paving. Portland cement concrete pavement should consist of a minimum of 6 inches of Portland cement concrete placed over 8 inches of compacted subgrade. The pavement should be constructed with load transfer joints designed for heavy traffic.

Increases in the subgrade moisture content can cause severe weakening of the soils, thereby, shortening pavement life and causing localized failure. This is particularly true early in the construction phase when paved areas are subject to heavy construction traffic. Therefore, all paved areas should be designed to drain completely and allow no ponding. Pavement materials should conform to materials as specified in the NMSHTD General Specifications for Road and Bridge Construction. All native subgrade soils should be compacted to a minimum of 95% of the maximum dry density determined by ASTM D-1557 density. All asphaltic pavement should be compacted to 96% of the maximum

Marshall Density.

MOISTURE PROTECTION

Precautions should be taken during and after construction to minimize saturation of the foundation soils. Positive drainage should be established away from building foundations.

Concrete walks and asphalt pavement should be constructed adjacent to the exterior foundations where possible. All backfill for utility trenches leading into the structure should be compacted.

FOUNDATION REVIEW AND INSPECTION

This report has been prepared to aid in the evaluation of this site and to assist in the design of this project. It is recommended that the Geotechnical Engineer be provided the opportunity to review the final design drawings and specifications in order to determine whether the recommendations in this report are applicable to the final design. Review of the final design drawings and specifications will be noted in writing by the Geotechnical Engineer.

Variations from soil conditions presented herein may be encountered during construction of this project. In order to permit correlation between the conditions encountered during construction and to confirm recommendations presented herein, it is recommended that the Geotechnical Engineer be retained to perform sufficient review during construction of this project. Observation and testing should be performed during construction to confirm that suitable fill soils are placed upon competent materials and are properly compacted and foundation elements bear on recommended soils that have been properly prepared.

CLOSURE

Our conclusions, recommendations, and opinions presented herein are:

(1) Based upon our evaluation and interpretation of findings of the field exploration and laboratory program.

(2) Based upon an interpolation of soil conditions between and beyond the explorations.

(3) Subject to confirmation of conditions encountered during construction.

(4) Based upon the assumption that sufficient observation will be provided during construction.

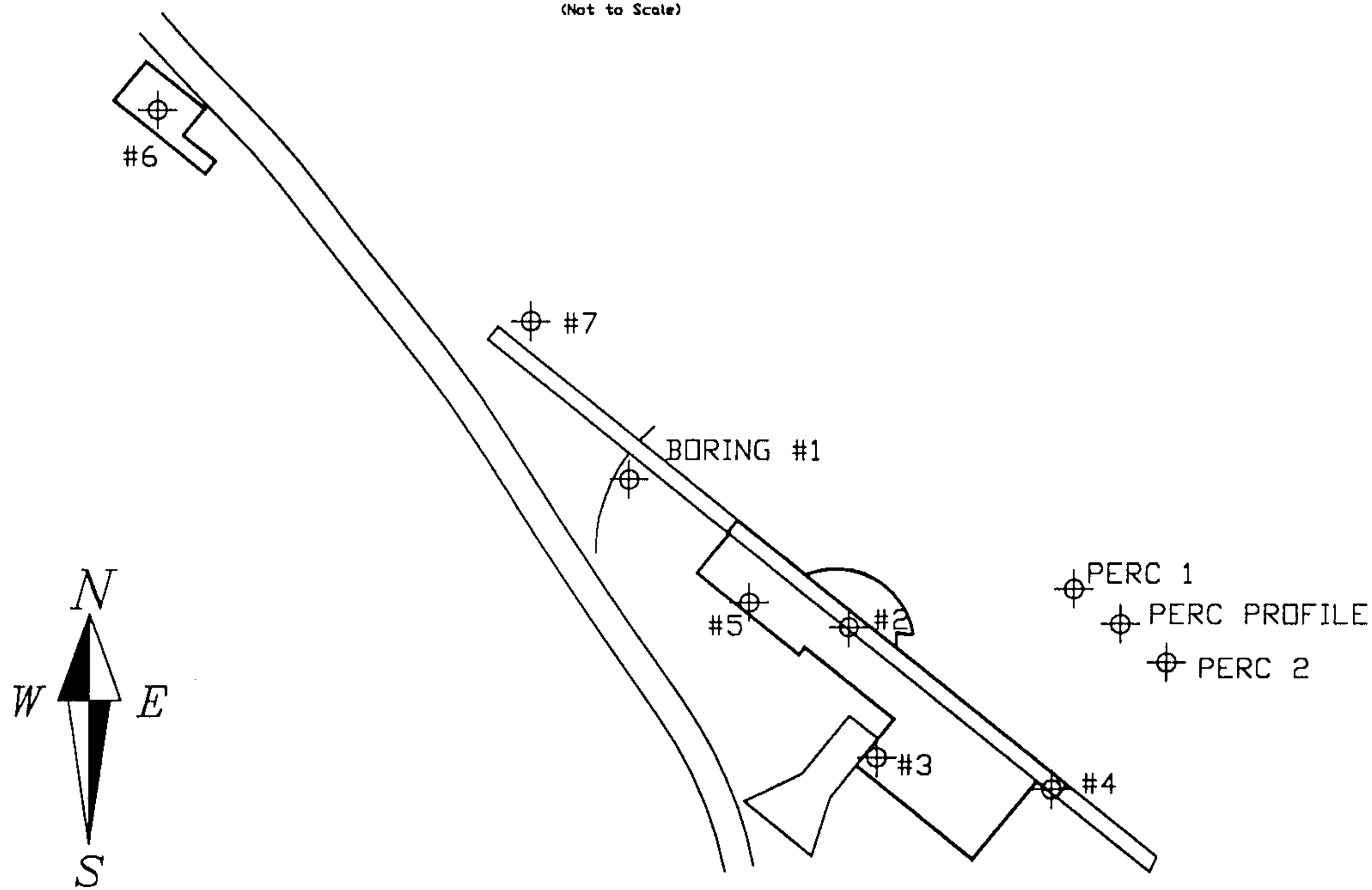
(5) Prepared in accordance with generally accepted professional geotechnical engineering principles and practice.

We make no other warranty, either express or implied. Any person using this report for bidding or construction purposes should perform such independent investigation as deemed necessary to be satisfied as to surface and subsurface conditions to be encountered and procedures to be used in performance of work on this project. If conditions are encountered during construction that appear to be different than those indicated by this report, **Geo-Test, Inc.** should be notified.

Variations from soil conditions presented herein may be encountered during construction of this project. In order to permit correlation between conditions encountered during construction and to confirm recommendations presented herein, it is recommended that the Geotechnical Engineer be retained to perform sufficient review during construction of this project.

BORING LOCATION MAP

(Not to Scale)



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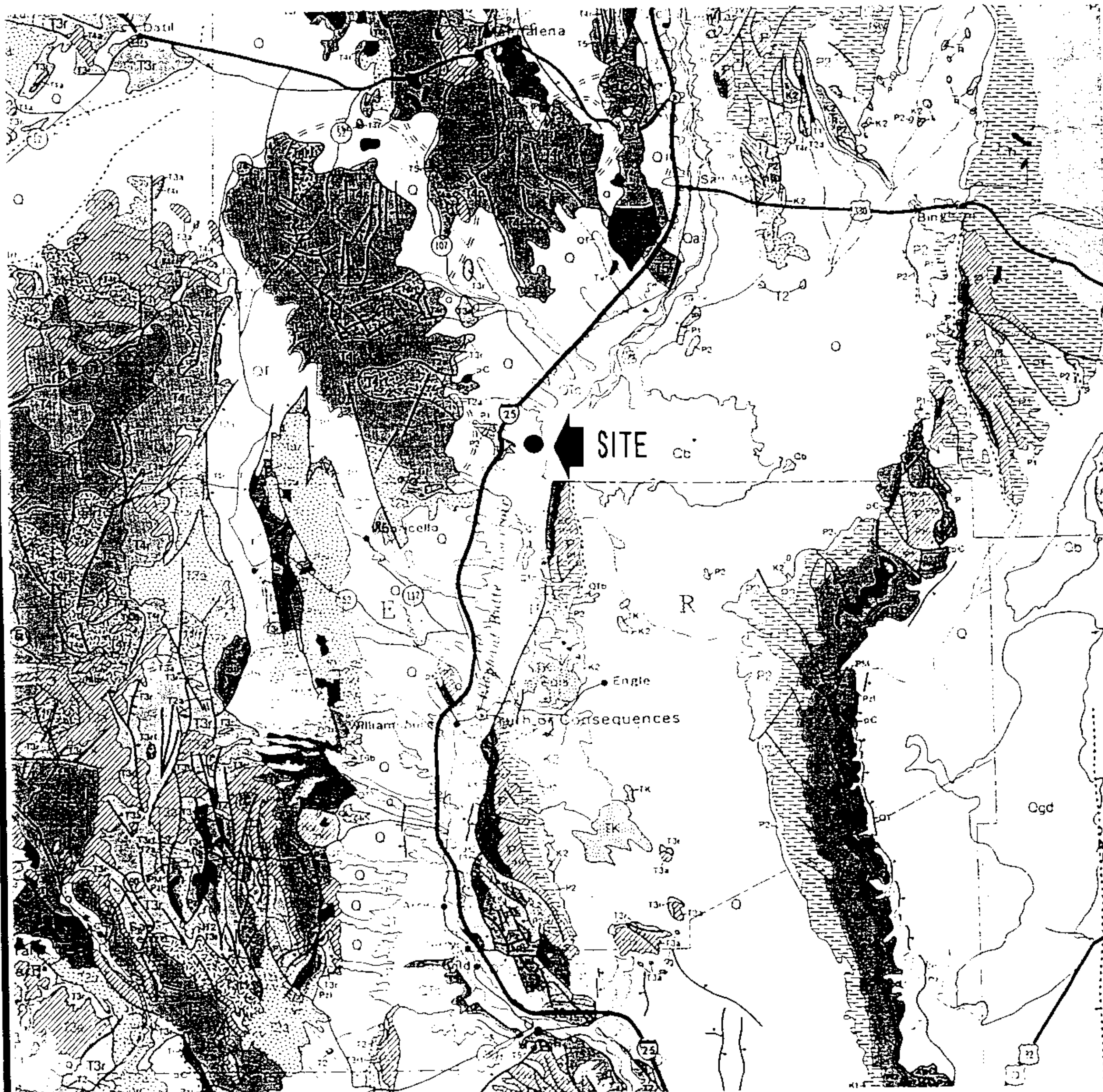
EL CAMINO REAL INT'L HERITAGE CENTER   NEW MEXICO   1–80706   FIGURE 1

GEOLOGIC MAP

(Scale = 1:1,000,000)



From: NEW MEXICO HIGHWAY GEOLOGIC MAP
NEW MEXICO GEOLOGICAL SOCIETY

Figure 2

GEO-TEST
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TEST BORING PROCEDURES

A soil test boring provides small samples of subsurface soil. The samples are used for classification and in laboratory testing to determine various properties of the soil. Our drilling and sampling is performed in general accordance with applicable ASTM standards.

In general, test borings are advanced by rotary equipment. When using solid or hollow stem flight augers, cuttings are returned to the surface on the flights of the augers and can be collected as disturbed bulk samples. In the case of hollow-stem augers, sampling can be accomplished through the hollow interior of the auger. If rotary drill bits are used, cuttings are flushed to the surface by a drilling fluid pumped through hollow drill rods. At sampling intervals, the drill bit is removed and replaced by a sampling device. The sampling intervals vary according to project data requirements.

Samples are commonly obtained by driving one of two standard sampling devices: 1) a 1.4-inch inside diameter (I.D.), 2.0-inch outside diameter (O.D.) split barrel sampler; and 2) a 2.4-inch I.D., 3.0-inch O.D. ring sampler. The samplers are driven with blows of a 140-pound hammer falling approximately 30 inches. The ring samplers are designed to obtain relatively undisturbed samples of subsurface soil. The samples are retrieved and visually classified in the field by an engineer or geologist. A representative portion of the sample is sealed in a container and transported to our laboratory.

In addition to providing a material sample, a driving resistance value is recorded based on the number of blows needed to drive the sampling device through a specific length of penetration. Penetration resistances provide a general indication of soil strength and density.

The subsurface conditions encountered at the boring locations are shown on the Test Boring Records. These records represent our interpretation of the subsurface conditions based on our field observations, a visual examination of samples by an engineer, and the indicated laboratory tests performed on selected samples. The lines designating the interface between various strata on the test boring records represent the approximate position of the interface. In addition, transitions between strata may be gradual. Ground water levels shown on the test boring records represent conditions only at the time of our exploration.

The designation shown in "Boring No." refers to the boring location illustrated on the Boring Location Map labeled with the same designation. The actual field boring locations were determined by measuring with a tape measure and turning estimated right angles to features shown on provided drawings of the project site and found at the site. The approximate boring locations are shown on the Boring Location Diagram and should be considered accurate only to the degree implied by the method of location used. If a more precise location is required, we recommend that a registered land surveyor locate the borings.

The date shown on the Record indicates the date when the boring was performed.

The designation shown in "Sample No." refers to a sample recovered during the exploration; this designation is also used to identify the samples in the laboratory test results.

"N/12"" refers to the number of blows of a 140 pound hammer falling 30 inches required to advance the sampler a distance of one foot. Driving resistance values for less than one foot are indicated by a value and the corresponding driving length in inches.

"Sample Type" refers to the following:

> "SS" refers to a 2-inch outside diameter (O.D.), 1.4-inch inside diameter (I.D.) split barrel sampler. Refusal to penetration is defined as more than 100 blows per foot.
>
> "UD" refers to a 2.42-inch I.D. ring sampler. Refusal to penetration is defined as more than 100 blows per foot.
>
> "AC" refers to a grab sample of auger cuttings.

"γ" refers to the dry unit weight in pounds per cubic foot of a representative portion of the sample as determined in the laboratory.

"M" refers to the moisture content as a percentage of the dry soil weight of a representative portion of the sample as determined in the laboratory.

"USC" refers to the classification of the soil as determined by a visual examination of the soil, and in some cases by laboratory tests, according to the Unified Soil Classification System.